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**ORNL
FOREIGN TRIP REPORT
TA 441191**

DATE: June 22, 2019 – June 27, 2019
SUBJECT: Attend the OECD/NEA Working Party Evaluation Cooperation
TO: Angela Chambers, Nuclear Criticality Safety Program Manager, National Nuclear Security Administration / NA-511/GTN, Pantex Plant, PO Box 30020, Amarillo, TX 79120-0020

FROM: Andrew M. Holcomb

MEETING: 31st Working Party on International Nuclear Data Evaluation Co-operation Meeting
TITLE
MEETING: Nuclear Energy Agency Headquarters; Paris France
LOCATION
MEETING: Monday, June 24, 2019 – Wednesday, June 26, 2019
DATES
ATTENDEES: Andrew Holcomb, Vlad Sobes, Doro Wiarda; others from BNL, LANL, and LLNL
ON BEHALF
OF NCSP
MEETING: ORNL's participation in the WPEC subgroup meetings is identified as a planned
BENEFIT TO foreign trip in the NCSP 2019-2023 Five Year Plan. Dr. Holcomb is an expert on
NCSP nuclear data evaluation and processing, and his participation in the WPEC subgroup meetings ensures a rigorous review of the current state of nuclear data. Helping ensure that international nuclear data evaluations maintain high-fidelity allows the data to be applied by DOE, NNSA, and commercial facilities throughout the country to perform nuclear criticality safety analyses with confidence.

MEETING The purpose of the trip is to participate in the Working Party on International Nuclear
PURPOSE: Data Evaluation Co-operation (WPEC) Meeting and various subgroup meetings related to nuclear data evaluation and validation efforts, including new methodologies, international validation collaborations, and covariance assessments.

SITES Nuclear Energy Agency Headquarters, Paris, France
VISITED:

ABSTRACT: The annual Working Party on International Nuclear Data Evaluation Co-operation Meeting ensures a globally recognized group of nuclear data experts direct the future reliability and accuracy of evaluated nuclear data libraries. Helping ensure that international nuclear data evaluations maintain high-fidelity allows the data to be applied by DOE, NNSA, and commercial facilities throughout the country to perform nuclear criticality safety analyses with confidence. Maintaining and improving the reliability, accuracy, and fidelity of nuclear data evaluations and the associated libraries ensures current and future confidence in the applications of nuclear data and methods to criticality analyses across the DOE, NNSA, and commercial facilities throughout the country.

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REPORT OF FOREIGN TRAVEL

**Andrew M. Holcomb
Paris, France
June 22 – 27, 2019**

PURPOSE OF TRAVEL

The purpose of the trip was to attend the annual Working Party on International Nuclear Data Evaluation Co-operation Meeting. This included participation in four different subgroups, namely: Subgroup 44 (Investigation of Covariance Data in General Purpose Nuclear Data Libraries), Subgroup 43 (Code infrastructure to support a modern general nuclear database [GND] structure), Subgroup B (Expert Group on the Recommended Definition of a General Nuclear Database Structure [EG-GNDS]), and Subgroup 45 (Validation of Nuclear Data Libraries [VaNDaL] Project). A day-by-day detailing of the meeting has been appended at the end of this document.

Persons Contacted at NEA Headquarters

The point of contact for WPEC at the NEA is Michael Fleming. The chair for the Subgroup 44 meeting was Vlad Sobes from ORNL in the USA. The chair for the Subgroup 43 meeting was Caleb Mattoon of LLNL in the USA. The chair of Subgroup B (an expert group) was Dave Brown of BNL in the USA. The Subgroup 45 chair was Morgan White of LANL in the USA. A number of individuals from different institutions at different countries make up the various WPEC subgroups and participated in the associated meetings. A listing of the meeting registrants can be found listed in the agendas for the subgroups here: https://www.oecd-nea.org/science/wpec/meeting2019/SG_Meetings/index.html.

Itinerary

6/22/19 – 6/23/19	Travel from Knoxville, USA to Paris, France
6/24/19	Paris, France (Subgroup 44)
6/25/19	Paris, France (Subgroup 43 and Subgroup B)
6/26/19	Paris, France (Subgroup 45)
6/27/19	Travel from Paris, France to Knoxville, TN

DISTRIBUTION

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2. Angela Chambers (angela.chambers@nnsa.doe.gov)
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6/22/2019 – 6/23/2019

Traveled to Paris.

6/24/2019

Participated in discussion of GNDS format proposal for thermal scattering law evaluation covariance data. Discussed a new approach to performing nuclear data evaluations to improve reproducibility and speed of new evaluation. Examined the application of a summation method to obtain a realistic uncertainties and correlations for fission yields. Reviewed the proposed augmented ENDF-VIII.0 covariance library adjusted using integral experiments to infer missing cross-correlations. Conferred on the status and requirements of current covariance matrices for the neutronic assessment of fast reactor cores. Afternoon session began with a discussion of complications associated with the identification and treatment of unrecognized uncertainties and their impact on evaluated uncertainties. Participated in an impromptu presentation by Dave Brown on Bayesian updates and Gaussian process regression as they are applied to cross section evaluations. Examined CSWEG covariance and measurement template initiative to create reasonable estimates of physical measurement limits to constrain uncertainty. Reviewed SG-44 scope and path forward with work assignments.

6/25/2019

Reviewed 2017 meeting on GNDS API working group structure and definition/implementation, discussed topics of interest for current meeting. Discussed collaborative efforts by the NEA to coordinate contributions to developing API implementations. Examined LLNL's implementation of the GNDS API in GIDI. Related design decisions in FISPACT API-II design and how those choices may help us understand what we want to do in GNDS. Studied LANL progress towards implementing GNDS support in NJOY. Participated in discussion of AMPX implementation of GNDS.

Afternoon session started with an overview of the previous WPEC meeting in May of 2019 and a brief rehash of the mini-meeting held

during the nuclear data conference in Beijing. We then debated over the proper way to manage minor bug fixes, major bug fixes, and format proposal inside of the recently adopted gitlab ecosystem. We went on to discuss the NEA GitLab and GNDS format proposal process. Discussed broad international perspective of philosophical perspectives of GNDS from the IAEA (Should the format be entirely application driven, science driven, or somewhere in between? Should we have our evaluations focused on a target application, such as shielding, criticality safety, activation, transport, etc.?).

6/26/2019

Introduced to the goals and objectives of the VANDAL project. Reviewed actions from the ND2019 meeting held in Beijing. Rehashed the NEA gitlab server, to be used as the main form of collaboration. Discussed possibility of VALID inputs being added to NEA repository via mirroring our public facing VALID git repository (probably best with using git submodule). Talked about navigating the morass that is US policy on control of data; there are several NSE articles and LANL reports that consistently publish benchmark data, so the community feels we are on firm ground in exchanging the data, specifications, inputs, etc. Continued discussion of applying modern software practices to our shared NEA repository for VANDAL (“collective code construction contract” C4 as guiding example). Explored some of the potential complications in correctly choosing our open-source license (GNU Free *Documentation* License rather than the usual software license). Afternoon session began with a discussion of the balance tables in the ICSBEP handbook and their existing deficiencies. Reviewed tools made available by the NEA that allow for application specific interrogation of data sets. The IRSN presented an inter-comparison study of some ICSBEP benchmark model k-eff computations between KENO, MCNP, COG, and MORET (complications from model revision matching and simplified vs. detailed modeling). Final presentation explained benchmark testing for nuclear data validation at the IAEA. LANL presented a JSON structure for exchanging calculation results between

cross validations. Session ended with an open discussion of all materials and topics presented.

6/27/2019

Traveled back to Knoxville.

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ORNL FOREIGN TRIP REPORT TA 441 531
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DATE: July 12, 2019
SUBJECT: Report of Foreign Travel to Paris and Fontenay aux Roses, France – Vladimir Sobes, Reactor and Nuclear Systems Division
TO: Angela Chambers, Nuclear Criticality Safety Program Manager, National Nuclear Security Administration / NA-511/GTN, Pantex Plant, PO Box 30020, Amarillo, TX 79120-0020

FROM: Vladimir Sobes

MEETING: OECD/NEA Working Party on Nuclear Data Evaluation Cooperation (WPEC)
TITLE Meeting and NCSP Nuclear Data Collaboration with IRSN
MEETING: NEA Headquarters, Paris, France; Institute of Radiological protection and Nuclear
LOCATION Safety (IRSN), Fontenay Aux Roses, France
MEETING: 06/24/2019 – 07/12/2019
DATES

ATTENDEES: Vladimir Sobes
ON BEHALF
OF NCSP

MEETING: The benefit of this travel is that it supports the Mission and Vision of the Nuclear
BENEFIT TO Criticality Safety Program in a number of ways. Foremost, this travel supports the
NCSP Mission of the Nuclear Data technical program element through the coordination of nuclear data activities and fostering a strong collaborative effort among international resources via active participation in the OECD/NEA Working Party Evaluation Cooperation (WPEC) expert working groups. Furthermore, this travel supports the ORNL Nuclear Data Milestone, ORNL-ND1, as detailed in the NCSP Five Year Execution Plan. The main purpose of the trip is for nuclear data research collaboration between ORNL and IRSN in support of timely completion of the nuclear data evaluations listed in the Appendix B of the Five Year Execution Plan. Details of the WPEC 2019 Meeting and collaboration with IRSN are provided below.

MEETING The purpose of the first week of this trip is for Dr. Sobes to lead the meeting of the
PURPOSE: WPEC Subgroup 44 on the Investigation of Covariance Data in General Purpose Nuclear Data Libraries during the 31st OECD/NEA WPEC Meetings. Dr. Sobes has been selected as the coordinator of this international subgroup. In this faculty, Dr. Sobes supports the Mission of the Nuclear Data technical program element of the NCSP by facilitating coordination of nuclear data activities by fostering a strong collaborative effort among international resources in this highly technical area. Active participation in the OECD/NEA Working Party Evaluation Cooperation (WPEC) expert working groups is explicitly called out in the NCSP Mission and Vision document. The mandate of Subgroup 44 sets out to improve nuclear data covariance

evaluations in general purpose nuclear data libraries, such as the ENDF/B library used by practitioners of nuclear criticality safety in the US. Quality nuclear data covariance information is essential to establishing safety margins in criticality calculations. The benefit to the NCSP is the exchange information with international NCS community to improve NCSP nuclear data work and cultivate new collaborations to support future NCSP nuclear data tasks which is in accordance with the specific milestone ORNL-ND1 set out in the NCSP Five Year Execution Plan FY2019-2023.

During the week of meeting, Dr. Sobes also actively participated in the meetings of HPRL Expert Group and Subgroup 46. The HPRL Expert Group is devoted to maintaining and prioritizing the nuclear data High Priority Request List, which serves as the parallel of the European nuclear data community to Appendix B of the NCSP Five Year Plan. Subgroup 46 is devoted to the topic of Efficient and Effective Use of Integral Experiments for Nuclear Data Validation and maintains strong collaborative ties with the efforts of Subgroup 44. As a subgroup coordinator, Dr. Sobes was also invited to participate in the WPEC committee meeting which coordinates the activities of the different WPEC subgroups and nuclear data research around the world.

The purpose of the collaboration visit to IRSN is for Dr. Sobes (ORNL) to collaborate with Dr. Luiz Leal (IRSN) and Dr. Raphaele Ichou on several nuclear data evaluation tasks listed in the NCSP Five Year Execution Plan FY2019-2023. Dr. Sobes is the PI at ORNL for the resonance region evaluation of ^{156}Gd , ^{158}Gd , and ^{160}Gd as indicated in Appendix B of the NCSP Five Year Plan and implied under the Milestone ORNL-ND1. Dr. Leal has been working in parallel on the resonance evaluation of ^{155}Gd and ^{157}Gd at IRSN. One of the objectives of this visit is for the two researchers to come together and synchronize their work, such that each can benefit from further working with the latest resonance parameters for the other isotopes of Gadolinium. The technical significance of this synchronization is that in the resonance analysis, experimental data are measured using natural samples and the analysis impacted by the resonances of all five isotopes. Therefore, it is natural, that changes to one or several of the isotopes will have an impact on the resonance parameters of the other isotopes. Thus, periodic synchronization is essential.

Dr. Ichou is leading the new resonance evaluation for the isotopes of ^{206}Pb and ^{207}Pb at IRSN. Dr. Sobes is leading the new resonance evaluations for the isotopes of ^{204}Pb and ^{208}Pb at ORNL. This collaboration presents several benefits to the NCSP. First, the NCSP and the US nuclear data community will benefit from two new resonance evaluations of ^{206}Pb and ^{207}Pb from IRSN at no cost or effort. Due to the close collaboration between ORNL and IRSN on the joint evaluation of the isotopes of lead, the cross sections for natural lead will be consistent even though the work of the evaluation is split between the two sites. The second major benefit comes in the form of sharing of benchmark and validation data. IRSN and ORNL are already collaborating in cross-validation exercises for integral experiments and this has revealed that both sites do not have many benchmarks in common. Therefore, collaboration on the validation of new evaluations is beneficial to both sites. Furthermore, IRSN has access to proprietary benchmarks. While the benchmark models may not be shared, validation of candidate evaluations is possible through the collaboration. The third, major benefit of the NCSP/IRSN collaboration on nuclear data is the exchange of differential experimental data. IRSN is proposing to lead a

new experimental campaign for measurements of the lead isotopes. Therefore, the NCSP and ORNL would gain new differential experimental data through the established collaboration.

SITES NEA Headquarters, Paris, France
VISITED: IRSN, Fontenay aux Roses, France

ABSTRACT: The traveler made a trip to the Institute of Radiological protection and Nuclear Safety (IRSN) to work collaboratively with the IRSN nuclear data team on the cross section evaluations in the resolved resonance region for isotopes of interest to NCSP and IRSN. In particular, gadolinium and lead. The traveler also was responsible for leading the meeting of WPEC Subgroup 44 on the “Investigation of Covariance Data in General Purpose Nuclear Data Libraries” during the 31st WPEC Meetings at the Headquarters of the NEA.

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REPORT OF FOREIGN TRAVEL

**Vladimir Sobes
Fontenay aux Roses, France
June 24, 2019 – July 12, 2019**

PURPOSE OF TRAVEL

The benefit of this travel is that it supports the Mission and Vision of the Nuclear Criticality Safety Program in a number of ways. Foremost, this travel supports the Mission of the Nuclear Data technical program element through the coordination of nuclear data activities and fostering a strong collaborative effort among international resources via active participation in the OECD/NEA Working Party Evaluation Cooperation (WPEC) expert working groups. Furthermore, this travel supports the ORNL Nuclear Data Milestone, ORNL-ND1, as detailed in the NCSP Five Year Execution Plan. The main purpose of the trip is for nuclear data research collaboration between ORNL and IRSN in support of timely completion of the nuclear data evaluations listed in the Appendix B of the Five Year Execution Plan.

The purpose of the first week of this trip is for Dr. Sobes to lead the meeting of the WPEC Subgroup 44 on the Investigation of Covariance Data in General Purpose Nuclear Data Libraries during the OECD/NEA WPEC 2018 Meeting. Dr. Sobes has been selected as the coordinator of this international subgroup. In this faculty, Dr. Sobes supports the Mission of the Nuclear Data technical program element of the NCSP by facilitating coordination of nuclear data activities by fostering a strong collaborative effort among international resources in this highly technical area. Active participation in the OECD/NEA Working Party Evaluation Cooperation (WPEC) expert working groups is explicitly called out in the NCSP Mission and Vision document. The mandate of Subgroup 44 sets out to improve nuclear data covariance evaluations in general purpose nuclear data libraries, such as the ENDF/B library used by practitioners of nuclear criticality safety in the US. Quality nuclear data covariance information is essential to establishing safety margins in criticality calculations. The benefit to the NCSP is the exchange information with international NCS community to improve NCSP nuclear data work and cultivate new collaborations to support future NCSP nuclear data tasks which is in accordance with the specific milestone ORNL-ND1 set out in the NCSP Five Year Execution Plan FY2019-2023.

Three of the highlights from the Subgroup 44 meeting led by Dr. Sobes which are relevant to the NCSP nuclear data program are summarized below. 1) Dr. Sobes presented work in collaboration with the University of Michigan on establishing covariance data for thermal scattering laws. This work comes at no cost to the NCSP as it is under NEUP funding. However, it is highly relevant, as criticality safety calculations are impacted by nuclear data covariance. While the NCSP actively supports thermal scattering law evaluations, there is currently no covariance data, and therefore the impact of the uncertainty on the applications cannot be quantified. 2) A joint discussion with Subgroup 46 was held on a new proposed framework for nuclear data evaluation which would promote reproducibility, consistency and quality control in nuclear data. 3) An international computational inter-comparison was proposed for estimating neglected cross-correlations in nuclear data libraries. This work will have significant impact on NCSP applications as it will affect the magnitude of the calculated uncertainty on criticality. In this case, international collaboration is essential to ensure the reliability of the estimated cross-correlations.

During the week of meeting, Dr. Sobes also actively participated in the meetings of HPRL Expert Group and Subgroup 46. The HPRL Expert Group is devoted to maintaining and prioritizing the nuclear data High Priority Request List, serves as the parallel of the European nuclear data community to Appendix B

of the NCSP Five Year Plan. Subgroup 46 is devoted to the topic Efficient and Effective Use of Integral Experiments for Nuclear Data Validation and maintains strong collaborative ties with the efforts of Subgroup 44. As a subgroup coordinator, Dr. Sobes was also invited to participate in the WPEC committee meeting which coordinates the activities of the different WPEC subgroups and nuclear data research around the world.

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Dr. Ichou is leading the new resonance evaluation for the isotopes of ^{206}Pb and ^{207}Pb at IRSN. Dr. Sobes is leading the new resonance evaluations for the isotopes of ^{204}Pb and ^{208}Pb at ORNL. This collaboration presents several benefits to the NCSP. First, the NCSP and the US nuclear data community will benefit from two new resonance evaluations of ^{206}Pb and ^{207}Pb from IRSN at no cost or effort. Due to the close collaboration between ORNL and IRSN on the joint evaluation of the isotopes of lead, the cross sections for natural lead will be consistent even though the work of the evaluation is split between the two sites. The second major benefit come in the form of sharing of benchmark and validation data. IRSN and ORNL are already collaborating in cross-validation exercises for integral experiments and this has revealed that both sites do not have many benchmarks in common. Therefore, collaboration on the validation of new evaluations is beneficial to both sites. Furthermore, IRSN has access to proprietary benchmarks. While the benchmark models may not be shared, validation of candidate evaluations is possible through the collaboration. The third, major benefit of the NCSP/IRSN collaboration on nuclear data is the exchange of differential experimental data. IRSN is proposing to lead a new experimental campaign for measurements of the lead isotopes. Therefore, the NCSP and ORNL would gain new differential experimental data through the established collaboration.

Dr. Sobes, Dr. Ichou and the nuclear data team at IRSN, reviewed the applicability and sensitivity of integral benchmarks to the four isotopes of lead and the different reactions. In the identified integral experiments, most has lead as a reflector material. This would indicate that the experiments would be heavily sensitive to the angular distributions of scattering in lead. There are also proprietary experiments with interstitial lead, which would could be used to validate the absorption cross section. Figure 1, shows one concrete example of the benefit to the NCSP of the NCSP/IRSN collaboration. Figure 1 shows the k-effective sensitivity profile for the different reactions and isotopes of lead calculated during the collaboration visit. The sensitivity profile for this particular benchmark, is not available in the international database at the NEA nor at ORNL. PMI-004 is a rare benchmark with an intermediate neutron spectrum which shows significant sensitivity to both ^{208}Pb and ^{207}Pb .

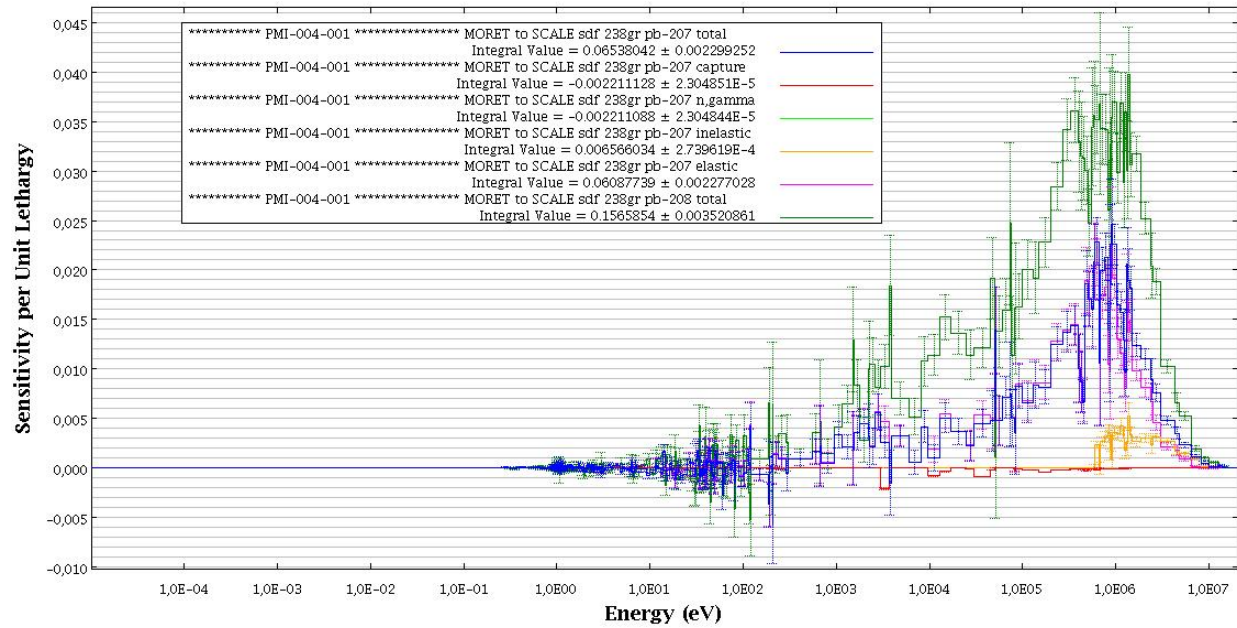


Figure 1: Sensitivity profile for PMI-004-001 to the isotopes of lead.

IRSN is proposing to lead a new experimental campaign for measurements of the lead isotopes. Dr. Sobes, Dr. Ichou and the rest of the IRSN nuclear data team worked together to identify and prioritize the experimental needs. Based on the freely available differential experimental data, the prioritized needs were determined to be:

1. Pb-207: capture up to 500 keV
2. Pb-208: angular distributions up to 1 MeV
3. Pb-207: transmission at two thickness up to 500 keV
4. Pb-206: transmission at two different thicknesses up to 1 MeV
5. Pb-206: capture up to 1 MeV
6. Pb-nat: capture up to 1 MeV
7. Pb-208: capture up to 1 MeV
8. Pb 204: capture 80 keV – 200 keV

Persons Contacted at IRSN

Luiz Leal, Host
Raphaelle Ichou
Nicholas Leclaire
Isabelle Duhamel
Stephan Ivo

Itinerary

06/22/19 – 06/23/19	Travel from Knoxville, TN to Paris, France
06/24/19 – 06/28/19	31 st WPEC Meetings. Conference agenda https://www.oecd- nea.org/science/wpec/meeting2019/SG_Meetings/index.html
07/01/19 – 07/05/19	IRSN, Fontenay aux Roses, France Resonance evaluation of $^{156,158,160}\text{Gd}$. Covariance evaluation. Evaluation of available differential experimental data for $^{204,206,207,208}\text{Pb}$. Evaluation of integral experimental data for validation of Pb evaluations.
07/08/19 – 07/12/19	IRSN, Fontenay aux Roses, France Evaluation of available differential experimental data for $^{204,206,207,208}\text{Pb}$. Evaluation of integral experimental data for validation of Pb evaluations. Computation of sensitivity profiles for integral benchmarks for Pb evaluations. Prioritization of differential experiment needs. Writing of foreign travel report.
07/13/19	Return Paris, France to Knoxville, TN

DISTRIBUTION

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Nuclear Energy Agency

NEA/SEN/NSC/WPEC(2019)2

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**NUCLEAR ENERGY AGENCY
NUCLEAR SCIENCE COMMITTEE**

Working Party on International Evaluation Co-operation

**31st Meeting of the Working Party on International Nuclear Data Evaluation
Co-operation (WPEC)**

SUMMARY RECORD

**27-28 June 2019
NEA Headquarters
Boulogne-Billancourt, France**

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OECD/NEA Nuclear Science Committee

WORKING PARTY ON INTERNATIONAL NUCLEAR DATA EVALUATION
CO-OPERATION 31ST MEETING

NEA Headquarters Room BB3
46 quai Alphonse Le Gallo, 92100 Boulogne-Billancourt, France

27-28 June 2019

SUMMARY RECORD

1. Welcome and membership

1.1. Welcome

The WPEC Chair, **A. Plompen**, opened the meeting and welcomed all participants (see *Appendix 1*) and the WPEC Secretariat, **M. Fleming**.

1.2. Adoption of agenda

[\[NEA/SEN/NSC/WPEC\(2019\)1\]](#)

To facilitate the participation of those presented remotely, the reports on the CENDL project and ND2019 conference were moved forward to take place immediately after item 4.1 in the agenda. The rest of the agenda was adopted without modification (see *Appendix 2*).

1.3. Review of WPEC membership and invited expert processes

The Secretariat, **M. Fleming**, reviewed the process defined in the OECD Rules of Procedure for nomination of members and invitation of experts to Working Parties of the Nuclear Science Committee, including WPEC. All official members not nominated in the period of the last WPEC mandate will be (re-)confirmed before participating in the WPEC-32 in 2020. The relevant representatives on the Nuclear Science Committee or OECD Permanent Delegations must issue these nominations. The NEA Secretariat will provide instructions to WPEC participants.

1.4. Nomination of next WPEC chairperson

The current WPEC Chair, **A. Plompen**, nominated **O. Iwamoto**, head of the JENDL project, to serve as the next Chair of the WPEC. He was unanimously confirmed by the participants and began his term at the end of the WPEC-31 meeting. This Chairmanship will continue through the WPEC-33 meeting in 2021.

2. Administrative items

2.1. Approval of WPEC-30 summary record [\[NEA/SEN/NSC/WPEC\(2018\)2\]](#)

The summary record for WPEC-30 was approved without modification.

2.2. Review of actions from previous meeting

The action items from WPEC-30, provided in *Appendix 3* of that summary record, were reviewed. All action items were completed, except actions related to the three subgroup reports that have had no demonstrable progress: 27 (**R. Jacqmin**), 36 (**P. Shillebeeckx**) and 41 (**H. Harada**). The Chair reminded all participants of the responsibility that they assume when proposing WPEC subgroups to lead the activities in fulfilling the agreed deliverables and reporting on the activity. He encouraged the future Chair to continue prioritising the reporting of subgroup activities.

2.3. Review of the status of subgroup reports

The Secretariat, **M. Fleming**, provided a report on the status of all WPEC subgroup reports. The average publication rate has been slightly higher than one report per year over the past 30 years, but no report has been published since 2014. To give a quick overview of the progress, the report drafts were classified into five states, ranging from preliminary draft (or none known to the NEA) to those finalised by the NEA Central Secretariat. Good progress has been made since WPEC-30 and three reports will be published in 2019.

2.4. Review of WPEC mandate and proposal for extension

The participants reviewed a revised mandate for the WPEC based on a streamlined copy of the previous mandate. Minor edits were made and the participants approved the revised draft provided in *Appendix 4*. Following review by the NEA Office of Legal Counsel it will be submitted via the OECD Written Procedure to the Nuclear Science Committee for approval.

3. Reports on activities from international organisations

3.1. Report on Nuclear Science activities at NEA

The Head of the NEA Nuclear Science Division, **T. Ivanova**, reviewed highlights of the Nuclear Science Committee activities, including the State-of-the-Art Report on Light Water Reactor Accident-Tolerant Fuels, the launch of an Expert Group on Reactor Core Thermal-Hydraulics, a new Technical Review Groups for SFCOMPO and SINBAD, the kick-off of the Nuclear Education, Skills and Technology Project and the international effort to create a Framework for Irradiation Experiments (FIDES) after the closure of the Halden Reactor in Norway. Various points were raised for the WPEC members to provide feedback on and these are detailed in *Section 9* of this document. She informed the participants of the new appointment of **M. Fleming** within the Nuclear Science

Division as both the Secretariat for WPEC and the Expert Group on Multi-physics Experimental Data, Benchmarks and Validation (EGMPEBV) and the appointment of **H. Hocquet** as the new assistant who will provide support to WPEC.

3.2. Report on Nuclear Data Section activities at IAEA

The Head of the IAEA Nuclear Data Section, **A. Koning**, reviewed progress made in the last year, including a renewed effort to collect fission yield data in advance of a new CRP on fission yield evaluation, a new Reference Database for Photon Strength Functions and a new Medical Isotope Browser that is available on the NDS website. Excellent progress has been made with the INDEN project, including a project on R-Matrix code comparisons and a comprehensive review of the CIELO evaluations with work in progress to address known deficiencies.

4. Reports on experimental activities

4.1. China

X. Ruan reported on experimental activities from the China Institute of Atomic Energy, including surrogate measurements at the HeSAN facility for (n,2n) and (n,f) reactions on actinides and capture measurements and light element (n, α /t) measurements at CSNS. New iron (n, α) measurements were performed at Peking University. The Institute of Modern Physics has been using its ADS superconducting LINAC to perform α -induced measurements on several materials and has now introduced ^{12}C beams in 2019. The China Academy of Engineering Physics performed experiments with the Fast Ionization Chamber for Fission Cross Section Measurement (FIXM) with preliminary results shown for the fission cross section ratio between ^{238}U and ^{235}U .

4.2. Europe

A. Plompen reported on the experimental activities that had been presented at JEFF meetings, highlighting talks that were given at ND2019 and the role of the EU CHANDA and ARIEL projects in guiding and funding work. The n_TOF programme, including numerous experiments performed by different institutions, has included measurements of $^{237}\text{Np}(n,f)$, $^{241}\text{Am}(n,f)$ and (n, γ), $^{33}\text{S}(n,\alpha)$, $\text{C}(n,p/d)$, $^{235}\text{U}(n,f)$ up to 150 keV and from 200 MeV to 1 GeV and $^{154}\text{Gd}(n,\gamma)$. New measurements carried out with GELINA and MONNET at JRC-Geel have included transmission and capture on ^{209}Bi , ^{103}Rh , $^{154,155,157}\text{Gd}$, $^{107,109}\text{Ag}$, $^{\text{nat}}\text{Ce}$, ^{51}V , ^{139}La and ^{142}Ce . Inelastic scattering using the GAINS detector has been used for several studies including ^{54}Fe , ^{16}O and ^7Li . Various fission observables are being studied with SCINTIA at JRC-Geel and STEFF at n_TOF.

4.3. Japan

A. Kimura reported on measurements at the J-PARC ANNRI experiment at the Materials and Life Science Experimental Facility, including total and capture measurements on $^{241,243}\text{Am}$, $^{135,137}\text{Cs}$ and $^{244,246}\text{Cm}$. New surrogate measurements at the JAEA Tandem facility have included ^{239}Np and $^{239,240}\text{Pu}$ fission barriers and ^{95}Zr neutron capture. Results from (p/d,xn) measurements at 50 and 100 MeV/u were shown for several elements with

Z=42-47. Results from the PHOENIX collaboration using NewSUBARU have generated many (γ, xn) and (γ, ln) measurements that have been the subject of an updated photonuclear data library and reference data for the photon strength functions within the IAEA CRP described in **Section 3.2**. Measurements by the National Institutes for Quantum and Radiological Science and Technology (QST) include new M1 transition strength for ^{52}Cr and neutron DDX from 290 MeV/u Xe(C, xn). Deuteron- and α -induced thick-target neutron yields from Kyushu University and RIKEN were shown for materials including C, LiF, Si, Ni, Mo, Ta and Bi.

4.4. USA

Y. Danon reported the activities presented at the 2018 CSEWG. New measurements at the LANL Chi-Nu experiment include energy-dependent PFNS for ^{235}U and ^{239}Pu with multi-chance and pre-equilibrium neutron emission separation. Work is ongoing at LENZ for $^{16}\text{O}(n, \alpha)$ and gas production cross sections in structural materials. An overview of the experiments carried out at JRC-Geel for the US Nuclear Criticality programme was provided, including a range of transmission and capture measurements for W, Cu, Ca, Ce, V, Zr and La. Results from the RPI Gaertner LINAC Center measurements of Ta were shown, including a novel set of data for the URR range from 5 keV, and lucite TSL data, with a new evaluation improving performance on integral benchmarks. Preliminary measurements taken at Gaertner on behalf of NNL for copper and hafnium show unresolved issues that will be reported on in future. Measurements at the University of Kentucky include differential elastic and inelastic scattering for ^{12}C and ^{28}Si , with preliminary data for ^{19}F and $^{\text{nat}}\text{Li}$. LBNL and UC Berkeley measurements include 2.5 MeV measurements of $^{35}\text{Cl}(n, p/\alpha)$ and $^{58}\text{Ni}(n, p)$, as well as 35-55 MeV $^{139}\text{La}(p, 6n)$ using the 88-inch cyclotron.

5. Progress reports from evaluation projects

5.1. CENDL

Z. Ge presented the progress of the CENDL project, which has a 3.2 beta version. This includes 270 files (up from 250 reported in 2018) with 77 new or updated evaluations, including ^{235}U , ^{239}Pu , ^{233}U , ^{232}Th , ^{56}Fe and ^1H . Results were shown for several evaluations, including significant focus on the revised iron evaluations. New fission product nuclei evaluations are included, based on the UNF code system. A new fission yield sub-library has been created and is complemented by a new decay sub-library that includes 1415 nuclides. A new activation sub-library is also provided, with fitting to 94 specific Chinese measurements shown in the presentation. A new photo-nuclear sub-library is included with calculations based on the GLUNF and MEND-G code packages. Various integral benchmarks have been performed and the release is expected in 2019.

5.2. ENDF

D. Brown highlighted recent advanced made in the ENDF/B-VIII.0 library that was released in 2018 and has now enjoyed a great deal of scrutiny from the user community in testing, validating and criticising the evaluations. The iron evaluations were a particular point of interest as transmission and shielding experiments have demonstrated

shortcomings that will be addressed in a revised evaluation. A new programme for the evaluation of fission product yields has begun, in parallel to the IAEA CRP and various measurements that were described in *Section 4.4* are being directly integrated into new evaluation efforts for their respective isotopes. New TSL evaluations for heavy paraffinic oil and liquid FLiBe are planned in 2019 that employ the FLASSH code and new developments specific to the GNDS formats.

5.3. JEFF

A. Plompen presented highlights from the JEFF-3.3 publication that is in an advanced draft and the state of the JEFF project after the release of the latest version in 2017. A six year plan has been agreed, including a three year period from 2018-2021 that will focus on methods improvement and be followed by a series of test files and enhanced engagement with stakeholders and users to ensure suitability of the new evaluated data. This will take advantage of new tools provided by the NEA for collaborating, version controlling and automating V&V for the test files. This is expected to benefit from the proposed subgroup in *Section 6.2*. New method developments from various JEFF participants were shown, as well as planned resonance range evaluations and fission yield codes planned to be used in the JEFF-4 evaluations.

5.4. JENDL

O. Iwamoto presented the JENDL/PD-2016 activation and JENDL/AD-2017 photonuclear data library, showing several examples of improvement with differential experimental data. A new special-purpose JENDL/ImPACT-2018 library was released, covering 163 nuclides up to 200 MeV that are produced as part of transmutation of fission products. A new JENDL-5 α 1 library has been created with new evaluations for Re, Pt and Tl and updated evaluations for 16 other elements including U, Pu and Am, which have benefitted from the new measurements carried out at ANNRI. A new R-matrix code, AMUR, has been created and used in the evaluation of ^{15}N , ^{16}O and ^{19}F , including covariances over the full incident energy range. New deuteron-induced evaluations have been created using a combination of CCONE and DEURACS to account for breakup processes. Results for 102 MeV DDX and 18 MeV TTY were shown to be in relatively excellent agreement. Plans for JENDL-5 include a new fission product yield sub-library, new decay data sub-library and a new TSL sub-library.

K. Yokoyama presented benchmarking and testing activities, where selections of criticality benchmarks were utilised to demonstrate issues with over-prediction of k_{eff} in several benchmarks. Evidence suggests that re-evaluation of TSL data will play a major role in balancing other changes made in major isotope evaluations.

5.5. TENDL

D. Rochman presented the TENDL evaluation methodology and progress made in the development of the TENDL-2019 library. This has been done in parallel to developments in the so-called T6 code package, including a new TALYS-1.95 and TARES-1.4 with various improvements, including new gamma strength functions, corrections to isomeric branching ratios, input parameter optimisation for several isotopes and corrections to TEFAL routines that generate the final ENDF-6 files. Considerable effort has been spent

preparing T6 as a portable and platform-independent package, which will be one of the first code packages considered in the new subgroup proposal described in **Section 6.2**.

6. Proposals for new subgroups

6.1. Subgroup on Advances in Thermal Scattering Law Analysis

A. Hawari presented a proposal for a new subgroup following on the successful completion of the WPEC subgroup 42 on *Thermal Scattering Kernel $S(\alpha, \beta)$: Measurement, Evaluation and Application*, which saw over 30 new TSL evaluations in a field that has historically generated few new evaluations in the past several decades. Subgroup 42 has already completely drafted its summary report and raised several points that should be addressed in follow-up activities. The proposed subgroup will carry on with the recommendations of subgroup 42 and is expected to make new and enhanced TSL evaluations. **WPEC unanimously approved the creation of this subgroup.**

6.2. Subgroup on Reproducibility in Nuclear Data Evaluation

D. Rochman presented a proposal for a new subgroup that will address reproducibility in nuclear data evaluations. While considerable improvements have been made in the reporting and documentation of evaluations, many evaluations, including the most essential for many applications, are not practically reproducible. This subgroup will use the NEA GitLab to prototype the systems required to make evaluations fully documented and reproducible. As part of this effort, model/code developers will be engaged in workshops to be held in 2019 to version control and containerise their tools. The NEA Databank Computer Program Service will be engaged to provide assistance in streamlining the program submission process for these codes. The Chair of the US CSEWG and the Head of the IAEA NDS remarked that this should have been WPEC subgroup 1. **WPEC unanimously approved the creation of this subgroup.**

7. Status of active subgroups

7.1. Expert Group on the High Priority Request List

E. Dupont reported on the progress with the High Priority Request List, including the implementation of new features to the list following the requests in the previous WPEC-30 meeting. This includes a new ‘feedback table’, entry status fields and archiving of completed entries. As the NEA begins the development of, and migration to, a new website with a Java Content Management System, users have been encouraged to share any feedback on the current system in order to provide enhancements on what will otherwise be as close as possible to a like-for-like replacement. Updates to the entries were shown, as well as the inclusion of new requests for $^{209}\text{Bi}(n, \gamma)$ and $^{239}\text{Pu}(n, \text{tot})$. An ND2019 paper will summarise the progress made since 2016.

7.2. Expert Group on the Recommended Definition of a General Nuclear Database Structure

D. Brown reported on the progress made in the development of the GNDS specifications. Since the launch of the NEA GitLab in 2018, the GNDS specifications have been ported over and actively developed with new over 1000 commits and a nearly 400 page document. The Expert Group agreed to formally release the GNDS-1.9 specifications based on the version that reflects the translation of ENDF-6. The NEA Secretariat will engage the Publications Division to identify the best method for releasing this document as an OECD publication. Several additions have been proposed and will go through a well-defined, collegial system for proposal acceptance utilising the GitLab merge request functionality. The procedure for this was drafted and agreed in the 2019 June meeting. A complete paradigm for development, proposals, hotfixes and releases was agreed at the meeting and work is ongoing for the next release, expected following the 2020 meeting.

7.3. Subgroup 43: Code infrastructure to support a modern general nuclear database (GND) structure

C. Mattoon reported on the progress of subgroup 43, where multiple partial or complete implementations of a GNDS API have been developed with the Fudge, GIDiplus and AMPX code packages. Additional work has started or is planned at LANL, CEA and JAEA. The progress of each will be included in a summary report that the subgroup co-ordinators have begun organising, and which will also include descriptions of the physics checking and verifications performed as part of the subgroup's activities.

7.4. Subgroup 44: Investigation of Covariance Data in General Purpose Nuclear Data Libraries

V. Sobes reviewed the presentations shown in the subgroup 44, covering a range of domains including cross section evaluations, assimilation-based correlations, fission yield covariances and the handling of model defects. The subgroup is working now to prepare a summary report and has agreed participants for various sections, although more contributions are welcome. A final inter-comparison will be performed with the cross-correlation of fission and nu uncertainties.

7.5. Subgroup 45: Validation of Nuclear Data Libraries (VaNDaL) Project

M. White reported on renewed activities in subgroup 45 with the launch of the NEA GitLab in 2018 and porting of input decks onto a private contribution space. More are expected in 2019 as users become more familiar and in the 2019 meeting several participants agreed to do so. An output JSON format has been specified for parsed simulation outputs and will be collaboratively developed through the NEA GitLab so that participants may identify discrepancies in their results and ultimately their inputs. A QA procedure document will be drafted, with **N. Leclaire** as the lead, based on the lessons learnt from different labs. Enhanced engagement with the ICSBEP community will take place to engage on any data dissemination issues and ensure a healthy dialogue.

7.6. Subgroup 46: Efficient and Effective Use of Integral Experiments for Nuclear Data Validation

G. Palmiotti reported on the progress of subgroup 46, which has begun a target accuracy requirements capture exercise from participants from different advanced applications to identify the operational parameters and accuracies required. These will then be translated, using feedback methodologies developed in the previous subgroups, into nuclear data requirements that can be posed to the HPRL (as was done with subgroup 26) and will help guide the next generation of evaluation efforts. Advances in assimilation methods were also presented, with enhancements of existing tools and the introduction of new methods that were presented in the subgroup meeting.

7.7. Subgroup 47: Use of Shielding Integral Benchmark Archive and Database for Nuclear Data Validation

A. Plompen, on behalf of **I. Kodeli**, reported on the kick-off meeting for subgroup 47, which attracted a large number of participants and presentations. Results from several SINBAD cases and new experiments that may be included in future SINBAD versions were shown. The NEA GitLab space for subgroup 47 has already been used to collect information related to new, proposed experiments and additional supplementary information related to existing SINBAD entries may be included in future, subject to outstanding permissions issues. These are expected to aid nuclear data evaluators and provide resources for the SINBAD Technical Review Group to review.

8. Conferences and meetings of interest

8.1. Report on the ND2019 Conference in Beijing, China

Z. Ge provided a summary of the ND2019 conference, which was attended by over 500 participants from 32 countries. He reminded participants that the conference papers will be published as an EPJ web conference and that full-paper submissions are due by 1 August 2019.

8.2. ND2022 in California, USA

C. Mattoon presented the plans for the ND2022 conference that will take place in Autumn 2022 in the San Francisco Bay Area, California, USA. Following the NSC-30 meeting earlier in June 2019 this conference has been approved. The local organising committee, including five national laboratories in the US, has been selected. The exact dates and venue will be selected in the near future.

9. Any other business

The participants discussed several items raised by the Head of the Nuclear Science Division, **T. Ivanova**, in the presentation of *Section 3.1*. All Working Parties of the NSC have been invited to provide metrics quantifying their impact as the NSC launches a Task Force to review and prioritise the activities of the NSC. All subgroups will send lists of related publications or other outputs that have been related to or directly created as a consequence of the subgroup's activities. All subgroups must additionally provide an *impact statement* to be used in high-level meetings. All projects are invited to propose

speakers for the upcoming NEA Radioactive Waste Management joint workshop in February, with a focus on multi-factor optimisation of pre-disposal.

Following the very engaging discussions that took place during the subgroup status updates, it was proposed that they be placed earlier in the agenda for WPEC-32 and that the Chair and Secretariat introduce in-depth discussions similar to those included in the NSC meetings.

10. Date and place of next meeting

The next meeting of the WPEC will take place on the week of 11-15 May 2020, with the Working Party meeting on the 14-15 May 2020.

Appendix 1

OECD NEA Nuclear Science Committee

31st meeting of the WPEC Working Party on International Nuclear Data Evaluation Co-operation

June 27-28, 2019
OECD-NEA Headquarters, Room BB3
46, quai Alphonse Le Gallo, 92100 Boulogne-Billancourt, France

More information for the schedule of subgroup meetings during the week at:
<https://www.oecd-nea.org/science/wpec/meeting2019>

PROPOSED AGENDA

1. Welcome and membership

- | | |
|--|-------------|
| • Welcome | Chair |
| • Review of WPEC membership and invited expert processes | Secretariat |
| • Nomination of next WPEC chairperson | All |

2. Administrative items

- | | |
|---|-------------|
| • Adoption of agenda
[NEA/SEN/NSC/WPEC(2019)1] | All |
| • Approval of summary record of the past meeting
[NEA/SEN/NSC/WPEC(2018)2] | All |
| • Review of actions from previous meeting | Chair |
| • Review of the status of subgroup reports | Secretariat |
| • Review of WPEC mandate and proposal for extension | Secretariat |

3. Reports on activities from international organisations

- | | |
|---|------------|
| • Report on Nuclear Science activities at NEA | T. Ivanova |
| • Report on Nuclear Data Section activities at IAEA | A. Koning |

4. Reports on experimental activities

- | | | |
|----------|-----------------------------------|------------|
| • China | Report on experimental activities | X. Ruan |
| • Europe | Report on experimental activities | A. Plompen |

- Japan Report on experimental activities A. Kimura
- USA Report on experimental activities Y. Danon

5. Progress reports from evaluation projects, discussion of future plans

- CENDL Status and updates Z. Ge
- ENDF Status and updates D. Brown
- JEFF Status and updates A. Plompen
- JENDL Status and updates O. Iwamoto / K. Yokoyama
- TENDL Status and updates D. Rochman

6. Proposals for new subgroups

- Subgroup on Advances in Thermal Scattering Law Analysis A. Hawari / G. Noguère
- Subgroup on Reproducibility in Nuclear Data Evaluation D. Rochman / M. Herman

7. Status of active subgroups

- Expert Group High Priority Request List for Nuclear Data E. Dupont (JEFF)
- Expert Group Recommended Definition of General Nuclear Database Structure D. Brown (ENDF)
- Subgroup 43 Code infrastructure to support a modern general nuclear database (GND) structure J. Conlin (JEFF)
- Subgroup 44 Investigation of Covariance Data in General Purpose Nuclear Data Libraries V. Sobes (ENDF)
- Subgroup 45 Validation of Nuclear Data Libraries (VaNDaL) Project M. White (ENDF)
- Subgroup 46 Efficient and Effective Use of Integral Experiments for Nuclear Data Validation M. Salvatores (JEFF)
- Subgroup 47 Use of Shielding Integral Benchmark Archive and Database for Nuclear Data Validation I. Kodeli (JEFF)

8. Conferences and meetings of interest

- ND2019 conference Beijing, China May 2019 Z. Ge (CENDL)
- ND2022 conference California, USA TBD 2022 C. Mattoon (ENDF)

9. Any other business

10. Date and place of next meeting

Appendix 2

List of participants to the 31st meeting of the WPEC Working Party on International Nuclear Data Evaluation Co-operation

	Given Name	Surname	Representing	Notes
1	David	BROWN	UNITED STATES	<i>EG-GNDS</i>
2	Roberto	CAPOTE	IAEA	<i>Remote</i>
3	Jeremy Lloyd	CONLIN	UNITED STATES	<i>SG-43</i>
4	Yaron	DANON	UNITED STATES	
5	Marie-Anne	DESCALLE	UNITED STATES	
6	Emmeric	DUPONT	FRANCE	<i>EG-HPRL</i>
7	Michael	FLEMING	NEA	<i>Secretariat</i>
8	Zhigang	GE	CHINA	<i>Remote</i>
9	Ayman	HAWARI	UNITED STATES	<i>SG-42</i>
10	Michal	HERMAN	UNITED STATES	
11	Jesse	HOLMES	UNITED STATES	
12	Tatiana	IVANOVA	NEA	
13	Osamu	IWAMOTO	JAPAN	
14	Nobuyuki	IWAMOTO	JAPAN	
15	Robert	JACQMIN	FRANCE	
16	Atsushi	KIMURA	JAPAN	
17	Arjan	KONING	IAEA	<i>Remote</i>
18	Luiz Carlos	LEAL	FRANCE	
19	Fausto	MALVAGI	FRANCE	<i>SG-43</i>
20	Caleb	MATTOON	UNITED STATES	<i>SG-43</i>
21	Gilles	NOGUERE	FRANCE	<i>SG-42</i>
22	Giuseppe	PALMIOTTI	UNITED STATES	<i>SG-46</i>
23	Arjan	PLOMPEN	EUROPEAN COMMISSION	<i>Chair</i>
24	Dimitri	ROCHMAN	SWITZERLAND	
25	Evgeny	ROZHIKHIN	RUSSIA	
26	Xichao	RUAN	CHINA	<i>Remote</i>
27	Vladimir	SOBES	UNITED STATES	<i>SG-44</i>
28	Alejandro	SONZOGNI	UNITED STATES	
29	Andrej	TRKOV	IAEA	
30	Morgan	WHITE	UNITED STATES	<i>SG-45</i>
31	Kenji	YOKOYAMA	JAPAN	
32	Michael	ZERKLE	UNITED STATES	

Appendix 3

List of Actions from the 31st meeting of the WPEC Working Party on International Nuclear Data Evaluation Co-operation

	Action	Responsible	Date
1	Provide NEA with any draft materials for the SG27 summary report	R. Jacqmin	November 2019
2	Provide NEA with any draft materials for the SG35 summary report	A. Plompen	November 2019
3	Provide NEA with any draft materials for the SG41 summary report	O. Iwamoto	November 2019
4	Prepare the final copy of the GNDS-1.9 specifications for NEA publication	D. Brown	September 2019
5	Identify a solution with NEA Publications for serial publication of GNDS specifications with citable identification numbers and public distribution	M. Fleming	January 2020
6	Submit WPEC mandate for approval of NSC and inform WPEC of status	M. Fleming	September 2019
7	Agree place and date of ND2022 conference and inform WPEC participants	C. Mattoon	May 2020
8	Liaise with representatives on the Nuclear Science Committee to (re-)confirm members of WPEC that will be given access to future meetings	All	April 2020
9	Identify in-depth discussion topics and organise presentations for WPEC-32	M. Fleming and O. Iwamoto	February 2020

Appendix 4

Revised Mandate

Working Party on International Nuclear Data Evaluation Co-operation (WPEC)

Members:	All NEA member countries
Full Participant:	European Commission <i>Under the NEA Statute</i>
Observer (International Organisation):	International Atomic Energy Agency (IAEA) <i>By agreement</i>
Date of creation:	30 October 1989
Start of current mandate:	1 July 2019
Duration:	30 June 2022

Mandate (Document reference):

- Status of the NEA Nuclear Science Committee Projects and their Evolution in 2007
[[NEA/SEN/NSC\(2006\)2](#)]
- Summary Record of the 17th Meeting of the Nuclear Science Committee (NSC)
[[NEA/SEN/NSC\(2006\)3](#)]
- Approved at the 20th Meeting of the Nuclear Science Committee [[NEA/SEN/NSC\(2009\)3](#)]
- Extended at the 21st Meeting of the Nuclear Science Committee [[NEA/SEN/NSC\(2010\)3](#)]
- Revised and extended at the NEA Nuclear Science Committee Bureau in December 2010
[[NEA/NSC/DOC\(2010\)14](#)]
- Revised and extended at the 24th Meeting of the Nuclear Science Committee in June 2013
[[NEA/NSC/DOC\(2013\)2](#)]
- Revised and extended at the 27th Meeting of the Nuclear Science Committee in June 2016
[[NEA/SEN/NSC\(2016\)2](#)]

Background and scope

The goal of the Working Party is to improve the quality and completeness of evaluated nuclear data available for use in science and technology and to promote the efficient use of available resources through international collaboration. The topics of the Working Party span the full range of nuclear data activities, including basic experimental measurements, theoretical developments, modelling/simulation of nuclear physics, formats and data structures, data processing, experimental data assimilation, verification and validation.

Objectives

The Working Party will promote the exchange of information on all nuclear data related topics and foster the adoption of best practices. The Working Party will provide a framework for co-operative activities between the participants and the nuclear data programmes that they represent. The Working Party will assess the needs for nuclear data improvements and address those needs by initiating joint evaluation, methods development or measurement efforts. The outcomes that the Working Party facilitates will be reflected in major evaluated data files.

In the three-year period, the Working Party will set out to complete the following tasks:

- Recommend improvements in evaluated nuclear data (including covariance data) for nuclear technology applications, in response to indications from stakeholders, new experimental data, theoretical and modelling advances, sensitivity and uncertainty analysis and integral validation/assimilation activities.
- Recommend updates in codes, formats, methods and practices for further improving the nuclear data evaluation process and streamlining their processing and use.
- Monitor and update the “High Priority Request List for Nuclear Data” (HPRL) to stimulate specific nuclear data measurement and evaluation activities.

The Working Party will liaise closely with other Nuclear Science Committee activities to ensure that data needs of nuclear science applications are properly addressed.

Deliverables

The deliverables of the WPEC during this mandate are the following:

- A continuously updated version of the “High Priority Request List for Nuclear Data”, accessible through the NEA web pages, which reflects the annual reviews of all progress made to satisfy these requests and new entries.
- A continuously updated specifications document for Generalised Nuclear Database Structures and repositories of the version-controlled documentation source code on the NEA GitLab.
- A report on prompt photon production from fission products.
- A report on processing of covariance data in the resonance region.
- A report on scattering angular distribution in the fast range.
- A report on evaluation of experimental data in the resolved resonance region.
- A report on fission yield evaluation methodologies and recommended improvements.
- A report on the development of a modern nuclear database structure beyond the current ENDF format.
- A report on methods and approaches to provide feedback from nuclear and covariance data adjustments to evaluators and experimentalists.
- An extended summary report on a joint assessment of six key isotopes, ^1H , ^{16}O , ^{56}Fe , ^{235}U , ^{238}U and ^{239}Pu , in the framework of the Collaborative International Evaluated Library Organization (CIELO) Project.
- A report on improving nuclear data accuracy of ^{241}Am and ^{237}Np capture cross-sections.
- A report on thermal scattering kernel $S(a,b)$ measurements, evaluations and applications.
- A report on code infrastructure to support a modern general nuclear database (GND) structure.
- A report on covariance data in general purpose nuclear data libraries
- A report on the Validation of Nuclear Data Libraries (VaNDaL) Project, including a suite of inter-comparison benchmark inputs and outputs.
- A report on the efficient and effective use of integral experiments for nuclear data validation.

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**ORNL
FOREIGN TRIP REPORT
TA 440627**

DATE: June 22, 2019 – June 27, 2019
SUBJECT: Attend the OECD/NEA Working Party Evaluation Cooperation
TO: Angela Chambers, Nuclear Criticality Safety Program Manager, National Nuclear Security Administration / NA-511/GTN, Pantex Plant, PO Box 30020, Amarillo, TX 79120-0020

FROM: Dorothea Wiarda

MEETING: 31st Working Party on International Nuclear Data Evaluation Co-operation Meeting

TITLE

MEETING: Nuclear Energy Agency Headquarters; Paris France

LOCATION

MEETING: Monday, June 24, 2019 – Wednesday, June 26, 2019

DATES

ATTENDEES: Dorothea Wiarda, Vlad Sobes, Andrew Holcomb; others from BNL, LANL, and LLNL
ON BEHALF OF NCSP

MEETING: ORNL's participation in the WPEC subgroup meetings is identified as a planned foreign trip in the NCSP 2019-2023 Five Year Plan. Dr. Wiarda is an expert in the ENDF formats and is working on adding the new GNDS format to the AMPX.
BENEFIT TO NCSP Among other subgroups, EG-GNDS and SG-43 are dealing with the development and API for the new format (see more details in the next paragraph). These new formats need to be implemented in AMPX and ORNL needs to have input into the format.s

MEETING PURPOSE: Participate in the sub-group meetings for the OECD/NEA Working Party Evaluation Cooperation (WPEC), specifically: SG-44, EG-GNDS, SG-43, and SG-45. EG-GNDS was established for the long-time governance of the ENDF/GNDS format. The SG-43 was established to provide and API and physics checks for the new ENDF format. The development and maintenance of the GNDS format is an international collaboration. New format proposals will be discussed, and it is important that a sufficient number of US representatives are present to ensure the best possible choices for the format. New formats are usually accepted by consensus of the people present at the meetings. Since this is the first time that the new GNDS format will be open for new format proposals, it is expected that there will be a lot of fruitful discussions concerning the extension of the formats.

SITES VISITED: Nuclear Energy Agency Headquarters, Paris, France

ABSTRACT: The annual Working Party on International Nuclear Data Evaluation Co-operation Meeting ensures a globally recognized group of nuclear data experts direct the future reliability and accuracy of evaluated nuclear data libraries. Helping ensure that international nuclear data evaluations maintain high-fidelity allows the data to be applied by DOE, NNSA, and commercial facilities throughout the country to perform nuclear criticality safety analyses with confidence. Maintaining and improving the reliability, accuracy, and fidelity of nuclear data evaluations and the associated libraries ensures current and future confidence in the applications of nuclear data and methods to criticality analyses across the DOE, NNSA, and commercial facilities throughout the country.

**Access to the information in this report is limited to those indicated
on the distribution list and to U.S. Government Agencies and their Contractors.**

REPORT OF FOREIGN TRAVEL

**Dorothea Wiarda
Paris, France
June 22 – 27, 2019**

PURPOSE OF TRAVEL

Participate in the sub-group meetings for the OECD/NEA Working Party Evaluation Cooperation (WPEC), specifically: SG-44, EG-GNDS, SG-43, and SG-45. EG-GNDS was established for the long-time governance of the ENDF/GNDS format. The SG-43 was established to provide an API and physics checks for the new ENDF format. The data processing code AMPX, used to generate cross section libraries for SCALE and the analysis code SAMMY, both of which are supported by NCSP, need to access, process and write data in the ENDF and/or GNDS format. Since the codes need to be kept current with the ENDF format and content, it is important that RNSD personnel is involved in the governance of the format as well as in the development of the API to ensure that our data needs are adequately addressed. In addition, influencing the physics checks that are applied to the data in any new ENDF library will ensure that the final library (after processing) can be used as is, as physics checks relevant to our transport codes are applied before the release of any updated ENDF library. A talk of the status of GNDS implementation in AMPX was given in SG-43. In addition, this included participation in SG-44 (Investigation of Covariance Data in General Purpose Nuclear Data Libraries), and SG-45 (Validation of Nuclear Data Libraries [VaNDaL] Project). A day-by-day detailing of the meeting has been appended at the end of this document.

Persons Contacted at NEA Headquarters

The point of contact for WPEC at the NEA is Michael Fleming. The chair for the SG-44 meeting was Vlad Sobes from ORNL in the USA. The chair for the SG-43 meeting were Caleb Mattoon of LLNL in the USA and Jeremy Conlin of LANL in the US. The chair of EG-GNDS was David Brown of BNL in the USA. The SG-45 chair was Morgan White of LANL in the USA. A number of individuals from different institutions at different countries make up the various WPEC subgroups and participated in the associated meetings. A listing of the meeting registrants can be found listed in the agendas for the subgroups here: https://www.oecd-nea.org/science/wpec/meeting2019/SG_Meetings/index.html.

Itinerary

6/22/19 – 6/23/19	Travel from Knoxville, USA to Paris, France
6/24/19	Paris, France (SG-44)
6/25/19	Paris, France (SG-43, and EG-GNDS)
6/26/19	Paris, France (SG-45)
6/27/19	Travel from Paris, France to Knoxville, TN

DISTRIBUTION

1. Doug G. Bowen (bowendg@ornl.gov)
2. Angela Chambers (angela.chambers@nnsa.doe.gov)
3. Lori Scott (Lorisc0tt@aol.com)

6/22/2019 – 6/23/2019

Traveled to Paris.

6/24/2019

Part of the session focused on the fact that the current covariance data in ENDF/B-VIII.0 are only based on differential measurements and does not account for the integral measurements that are also often taken under consideration. A consensus is slowly emerging on how to update the covariance information to account for the additional information, with talks by V. Sobes and H. Herman. It was discussed to retain as much information as possible from the evaluation in the final library or ancillary files.

In addition, a new format for scattering law evaluation covariance data was discussed. These data are not currently available in ENDF, partly because they have not been generated and partly because there is no format for it. It is assumed that the new format will only be available in the GNDS format to allow processing codes and transport codes to investigate the impact of uncertainty on the thermal scattering data. Participated in discussion of GNDS format proposal for thermal scattering law evaluation covariance data.

Reviewed SG-44 scope and path forward with work assignments.

(Detailed agenda: https://www.oecd-neo.org/science/wpec/sg44/meetings/2019_june/index.html)

6/25/2019

In the SG-43 session progress toward the GNDS implementation into various processing codes was discussed, with talks from representatives of GIDI and FUDGE (LLNL), NJOY (LANL), FISPAC (UK). Since the format was initiated in LLNL to replace the aging ENDL file format, GIDI and FUDGE show the greatest progress. AMPX has a two-tiered system and lately adopted a way to automatically generate low level API classes from the JSON files that are used as the official definition of the GNDS format. It was stressed by all that the current crop of

implementation does not represent an API suitable for users not intimately familiar with the format but could be used as a lower level on which to build such an API. Fausto Malvagi stressed that it might not be good to have only one implementation of the API or even only one API, in order to prevent the same processing mistake in all codes. However, as opposed to previous meetings of this sub-group, a greater consensus was reached on what constitutes low level access codes, and user accessible API. (Detailed agenda and talks: https://www.oecd-neo.org/science/wpec/sg43/meetings/2019_june/index.html)

The main topic of discussion in the EG-GNDS meeting was to establish a procedure on how to accept new format proposals. Since the format is new, it is expected that a large number of format proposals are going to be submitted (some of them already in the pipeline). Therefore, discussing the format proposals at an in-person annual meeting might be unfeasible. Therefore, a process using the gitlab server at the NEA was proposed at the mini-meeting during the nuclear data conference in Beijing and fleshed out during this session. Detailed outlines of the process are given in https://www.oecd-neo.org/science/wpec/gnds/meetings/2019_june/index.html.

In addition it was discussed whether the format as current in NEA gitlab server should be accepted as the official GNDS-1.9 format, even so it is not perfect but might give a solid bases on which to add formal format proposals. The ENDF/B-VIII.0 library was released in that format (albeit there are some translation not format errors in the covariance section). The proposal was not yet accepted as the Japanese representative wanted additional time to read the final document.

A final talk by J. Ch. Sublet urged the community to make sure that the format is defined broadly enough to support a wider array of uses than the current ENDF format, as the new format allows to take away some of the constraints that were enforced by the rigid ENDF file format (due to its development in the era of punch-cards).

(The web-page for the sub-group can be found here: <https://www.oecd-neo.org/science/wpec/gnds/>)

6/26/2019

Introduced to the goals and objectives of the VANDAL project. Reviewed actions from the ND2019 meeting held in Beijing and discussed how the NEA gitlab server is to be used in storing the input decks for the various test suites used. Every institution has their own set of test suites, where overlap is not always easy to find. A talk by I. Duhamel (IRSN), on the inter-comparison study of some ICSBEP benchmark model k-eff computations between KENO, MCNP, COG, and MORET highlighted how different naming and indexing might make it hard to identify input decks that are directly comparable. (complications from model revision matching and simplified vs. detailed modeling). It was discussed, which decks can be shared, what the best way is (can they be uploaded to the NEA git-lab, can a submodule be used as we would propose for the VALID input decks). In addition, how is proprietary or classified information to be treaded. For example, could the module contain the element but not the abundances. In this case, could there be a post-processing code in each institution that restores the abundances or other classified information. In addition, Wim Haeck (LANL) presented a JSON structure for exchanging calculation results between cross validations. (Detailed agenda: https://www.oecd-neo.org/science/wpec/sg45/meetings/2019_june/index.html)

6/27/2019

Traveled back to Knoxville.